

Self-Correcting Sensor for an Entrance

Technical Field

5 Photocells, light beam sensors and other radiation devices for detecting the motion or presence of persons or objects in entranceways and automatic doors are mounted in flexible holders to avoid permanent damage from contact with moving vehicles and the like. The holders are designed to return to an original orientation if they are bent or distorted temporarily.

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Background of the Invention

In the automatic industrial door and overhead door industry, there is a concern that, once activated, a moving door may injure persons or property inadvertently 15 in the path of the door. See **Richardson's US Patent 5,964,058**, which uses an electrical contact to trip a relay to reverse the motion of the door. More commonly, light beams are used at levels where they are apt to be interrupted by pedestrian traffic or vehicles such as automobiles, trucks, fork lifts and the like in order to prevent injury or damage to the vehicles. Safety light or other radiation 20 beams are also used for automatic household garage door opening systems, to assure that the door will stop or reverse its downward motion if the area beneath it is suddenly occupied by a toddler, for example. Halting or reversing the motion of the door without touching the object or person breaking the beam has proven to be an effective safety procedure.

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Typically the beam generators and the photocells are installed in metal or other rigid brackets in the door jambs or on adjacent walls. See, for example, **Mathis US Patent 6,209,262**, **Duhame US Patent 5,285,136**, **Catlett et al US Patent 4,006,392** (sliding door), **Boetsch et al US Patent 5,166,681**, **Harvey US Patent 6,179,036** (light beam for a truck door) and **Alexander US Patent 5,459,963**. The beam may also be mounted within a flexible tube on the bottom of a

vertically moving door. See **Miller** US Patent **5,728,984**, and **Strand** US Patents **5,079,417** and **5,399,851**.

Little attention has been paid in the industry, however, to the vulnerability of the
5 photocell supports and supports for light beam or other radiation devices to
damage from errant vehicles and other moving objects. Particularly where the
light beam projector, photocell, microwave or infrared device or photo receptor
holder must protrude from the door jamb, wall, door or other base, the holder is
highly likely to be damaged at some point over a period of time. Fork lifts, for
10 example, can be difficult to steer and often contain awkward loads which may
accidentally impact the light beam generator or receptor. Even in household
garage applications, the support for a light beam generator or receptor cell may be
damaged not only by automobiles, but possibly by lawnmowers or other utensils
typically stored in the garage.

15 In US Patent **4,953,608**, **Larsson** describes a displaceable photocell support arm.
The arm is slidable within a sleeve on the underside of a door, so that when a base
member or abutment on the lower side of the photocell hits the floor, the support
arm can slide into the sleeve. While the support arm is displaceable, it is not
20 especially adapted for protection against a transverse impact, and in fact a
transverse blow would impair its movement by rendering it incapable of sliding in
the sleeve.

Myeress, in US Patent **3,864,837**, shows a shroud for a light beam generator.
25 The shroud provides a mounting and a pivot axis for the light beam generator.
The device is used in surveying.

The **Larsson** and **Myeress** devices mentioned above will not solve the problem of
damaged supports for photocells and beam projectors. It must be recognized
30 that the light beam must be directed at the photocell and the photocell must be
oriented to receive the light beam. If either is twisted so there is no

communication between them, the system becomes totally inoperable, completely defeating any planned safety measures.

Motion and presence detectors used in doorways do not necessarily require
5 separate emitters and receivers on opposite sides of the doorway. As is known in
the art, microwave, infrared, and ultrasound emitters can be designed and used to
detect a disturbance in a background pattern of reception. For such installations,
a single radiation transceiver on one side of the doorway or entrance will suffice.
The transceiver will emit, for example, a microwave signal in a direction
10 transverse of the doorway, receive a background pattern represent the area in its
usual vacant state, and transmit such a pattern to a microprocessor or other device
for comparison to a pattern received when the picture is disturbed by the entrance
of a person or object. Such a transceiver, using light, microwave, infrared,
ultrasound, or other radiation, may be mounted in a single holder near the door,
15 and is also available for use in our invention.

I am not aware of any support or mounting for a photocell, light beam transmitter
or other beam or radiation transceiver which can continue to operate even if it is
twisted or bent.

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Summary of the Invention

We have invented a photocell or other radiation assembly that can recover
immediately from an impact or blow. In a preferred version, our device
25 comprises a generally tubular support, flexible in at least a portion of its length,
having a base end and a working end, containing a photocell (for example) on its
working end, through which the necessary wires are placed for connection to the
photocell or light beam transmitter. The base end is fastened preferably to a door
jamb or adjacent structure, and the working end is oriented to perform a beam
30 projection or reception, or other radiation emission or reception, or both. In the
door environment, the system may be placed at a height useful for safety to

- persons or property – that is, at a height so the beam will detect the unexpected or risk-prone presence of a person or object for triggering a reversal of the door's movement, or for some other safety procedure. By flexible in at least a portion of its length, we mean the generally tubular support will, if impacted and bent,
- 5 return to its original shape and configuration immediately on release of the deforming force that caused it to be bent. That is, the tubular support will have a shape memory which will enable it to return to its original shape after being distorted.
- 10 It should be understood that a photocell is used herein illustratively as a paradigm, and can be a device capable of both generating a light beam and detecting a light beam. While photocells are well known in the industry and we prefer to use them, our invention applies as well to devices capable only of one function or the other – either transmitting a light beam or detecting (receiving) it.
- 15 In a broader aspect, our invention comprises a projecting support for a photocell, infrared element, ultrasound element, light beam generator, or light beam receiving element, or any other radiation transmitter, receiver, transceiver, adapted to return to its original shape and/or orientation immediately on release of
- 20 a force which caused it to become inoperable by altering its shape. Our invention, indeed, is applicable to direction sensitive transmitters and detectors, and other presence or motion detection sensors, including radar, laser, sound, infrared, camera, and any other sending/receiving device for mounting near a door or entranceway that may be made inoperable by damage to its support member.
- 25 The devices may be active or not – that is, they may transmit radiation for reception by another element, or for reflection back to the transmitting device, or they may simply receive ambient radiation, such as ordinary light or infrared energy. Any such device, active or passive, may be called herein a radiation element.

We intend for the technical and other words used herein to have the meaning normally attributed to them by workers skilled in the art of door monitoring and control, but it may be useful to discuss briefly their use in the context of the description and claims hereof. A **sensing element** is a transmitter, receiver, or transceiver; it may be for light, microwave radiation, infrared radiation, ultrasound, or any other type of radiation or energy used for presence or motion detection. When directed at the area near a doorway, at least one sensing element will generate an electrical signal representing items or background in the area of the doorway, or simply whether a beam has been broken. A **detection system** is an electrical system for receiving the electrical signal from at least one sensing element and comparing it to a pattern or normal state for the doorway, or acting on a signal representing a broken beam to generate a further signal such a control signal for causing the motion of an overhead door to reverse itself. As used herein, a **photocell** is a sensing element which is either a light transmitter, light receiver, or light transceiver, but may be considered generally to represent any or all of the presence or motion detection devices mentioned herein.

Brief Description of the Drawings

20 **Figure 1** shows a photocell mounted for a 90° orientation in our flexible support, together with a base for fastening the support to a door jamb or other structure.

Figure 2 is a similar view, but the photocell is installed at the end of the flexible support, and the interior wiring is visible.

25 **Figures 3a and 3b** show a typical installation at a doorway, one of the flexible supports having been bent by the load on a forklift.

Detailed Description of the Invention

Referring now to the preferred version shown in **Figure 1**, elongated flexible support 1 is shown attached to base 2. The elongated flexible support 1 has two openings – side opening 3 and end opening 4. In this version, photocell 5 is installed in side opening 3. Base 2 has holes 6 for screws or other fasteners to fix it to a door jamb or other structure near the door, not shown. Elongated flexible support 1 is made of a rubbery material preferably tough enough so that if it is bent completely – even more than 90°, it will spring back to its original shape.

That is, the flexible support 1 has a memory which permits it to resume its original shape and form as soon as a deforming force is released. It may be made of Tygon®, silicone rubber, or other material having flexibility and memory such that it will spring back to its original shape on removal of a bending or distorting constraint. Satisfactory materials include materials having a Shore hardness A, as determined on a durometer, of 40 to 80, preferably 50 to 70, although we do not intend to be limited to these ranges, as the thickness of the material may also have an effect.

In **Figure 2**, a unit similar to that of **Figure 1** is shown, except that a photocell 10 is mounted in end opening 4 (see Figure 1) of the flexible support 1. Also, the hollow center area of the flexible support 1 is shown to be exposed so that wires 11 can be seen leading to and from photocell 10. Wires 11 provide power and/or lead to a detection system that may include a microprocessor or simpler device for interpreting a perturbation of the pattern normally received by the transceiver.

Figure 3a is a more or less simplified view of a doorway 21 having a light beam transmitting device 22 and a light beam receiver 24 on opposite sides of the doorway 21. As seen also in **Figure 3b**, device 22 and receiver 24 form a two-element arrangement for determining the presence of an object or person in doorway 21. The two-element system may have the purpose of overriding a control which otherwise would close an overhead door 23. For example, the

downward movement of overhead door 23 may be reversed if, after a vehicle has passed through, a second object breaks the beam. In **Figure 3a**, the load on forklift 20 has impacted beam transmitting device 22, bending it. In **Figure 3b**, the forklift 20 has moved through doorway 21, and the beam transmitting device 5 22 has reoriented itself in the original position, restoring the door to normal working order – that is, light beam 25 now passes directly from beam transmitting device 22 to light beam receiver 24. It may be noted that transmitting device 22 and receiver 24 are both deployed in the orientation of **Figure 1** – that is, the functionality of sending and receiving is oriented at 90° from the axis of elongated 10 flexible support 1.

It may therefore be understood that our invention includes a self-correcting sensing element device comprising a base, a generally elongated flexible support member having a base end, a working end, and an axis in the direction of elongation, the base end fastened to the base, and a sensing element in the working end, the generally elongated flexible support member being capable of returning to its original shape after being deformed.

In another aspect, our invention includes a safety system for an automatic door, 20 for detecting the presence of a person or object in the path of a door in the process of opening or closing, comprising at least one radiation element positioned to detect presence or motion in or near the door and an electrical presence detecting system responsive thereto, wherein the at least one radiation element is mounted on a flexible, generally elongated support, the flexible generally elongated support 25 being capable of returning to its original shape immediately after the release of a bending force.

In yet another aspect, our invention includes a system for detecting the presence of a person or object in the path of an automatic door in the process of opening or 30 closing, comprising a presence detecting system including at least one radiation transmitter on one side of the door and at least one radiation detector on the other

side of the door, wherein the transmitter and the detector are mounted on flexible, generally elongated supports, the flexible generally elongated supports being capable of returning to their original shape immediately after the release of a bending force.